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प्लास्टिक — परीक्षण पद्धतियाँ

भाग 11 विशेष गुणधर्म

अनुभाग 13 फिल्म और शीटिंग — कोल्ड-क्रैक तापमान ज्ञात करना

Indian Standard

PLASTICS — METHODS OF TESTING

PART 11 SPECIAL PROPERTIES

Section 13 Film and Sheeting — Determination of Cold-Crack Temperature

ICS 83.080.01

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 2006

Price Group 3

Plastics Sectional Committee, PCD 12

NATIONAL FOREWORD

This Indian Standard (Part 11/Sec 13) which is identical with ISO 8570 : 1991 'Plastics — Film and sheeting — Determination of cold-crack temperature' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Plastics Sectional Committee and approval of the Petroleum, Coal and Related Products Division Council.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to the following International Standard for which Indian Standard also exists. The corresponding Indian Standard which is to be substituted in its place is given below along with its degree of equivalence for the edition indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 291 : 1997 Plastics — Standard atmospheres for conditioning and testing	IS 196 : 1966 Atmospheric conditions for testing (*revised*)	Technically Equivalent

The technical committee responsible for the preparation of this standard has reviewed the provisions of the following International Standard and has decided that it is acceptable for use in conjunction with this standard:

International Standard	*Title*
ISO 4593 : 1979	Plastics — Film and sheeting — Determination of thickness by mechanical scanning

For tropical countries like India, the Standard temperature and the relative humidity shall be taken as 27 ± 2°C and 65 ± 5 percent respectively.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

PLASTICS — METHODS OF TESTING

PART 11 SPECIAL PROPERTIES

Section 13 Film and Sheeting — Determination of Cold-Crack Temperature

1 Scope

This International Standard specifies a method for assessing the brittleness of plastic film and sheeting at low temperature.

The assessment is given in the form of a conventional cold-crack temperature which serves as a guideline for comparing the low-temperature behaviour of plastic film and sheeting.

This method characterizes a finished product of given thickness and texture, but not its raw-material composition. Data derived using this International Standard cannot be transposed without limitation to any other shapes or conditions of application.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 4593:1979, *Plastics — Film and sheeting — Determination of thickness by mechanical scanning.*

3 Definition

For the purposes of this International Standard, the following definition applies.

3.1 cold-crack temperature: The temperature at which 50 % of test specimens break or exhibit damage when tested by the method specified in this International Standard.

4 Principle

Specimens bowed in the shape of a loop are placed in a cooling chamber and subjected to sudden folding under the impact of a free-falling mass.

The test is repeated at temperatures scaled in increments of 5 °C, commencing when no specimen breaks or is damaged and ending when all specimens are broken or damaged.

5 Apparatus

The following description is an example of a typical test apparatus design (see figure 1). Other designs can be used provided that the physical principles are equivalent. Figure 2 shows another appropriate design.

5.1 Impact device, comprising the following elements:

5.1.1 Specimen holder, permitting the fastening of one or more specimens on a platen by means of clamps (e.g. leaf springs) to clench each specimen along its entire width (15 mm) and to secure 10 mm of each end of the loop (see figure 1) so that the length of the loop section subjected to folding is 40 mm.

The platen may be equipped with a mechanism (revolving type) that allows each specimen to be placed successively in the test position under the guide tube (5.1.4) which guides the impact mass (5.1.3).

Another possibility is to equip the test apparatus with guide tubes each provided with its own impact mass. The guide tubes may be arranged in a line or in a circle, depending on the space available in the cooling chamber (5.2).

5.1.2 Rigid anvil, connected to, or part of, the specimen holder (5.1.1), and on which the specimen is brought into the test position.

5.1.3 Two impact masses, one 200 g, the other 500 g, consisting of metal cylinders with a diameter of not less than 18 mm and not more than 29 mm, the edge of the lower face being slightly rounded.

5.1.4 Guide tube, to guide the impact mass (5.1.3), equipped at the upper end with a mechanism to release the mass (solenoid or mechanical trigger).

This tube, approximately 250 mm long and with a diameter 1 mm larger than that of the impact mass, shall be placed vertically above the specimen test position and shall be mounted so that the drop height, i.e. the distance between the base of the impact mass and the anvil, is 200 mm ± 2 mm.

5.1.5 Holding device, to align the platen and the guide tube (5.1.4) in such a position that the centre of the impact mass coincides with the edge of the flattened loop (20 mm from the clamp).

5.2 Cooling chamber, to house the impact device (5.1), allowing the temperature to be lowered in steps of 5 °C, and able to maintain a temperature constant to within ± 1 °C.

5.3 Thermometer, graduated in 0,5 °C, or **thermocouple**, with an accuracy of 0,5 °C, placed in the cooling chamber (5.2) in the proximity of the specimens.

Dimensions in millimetres

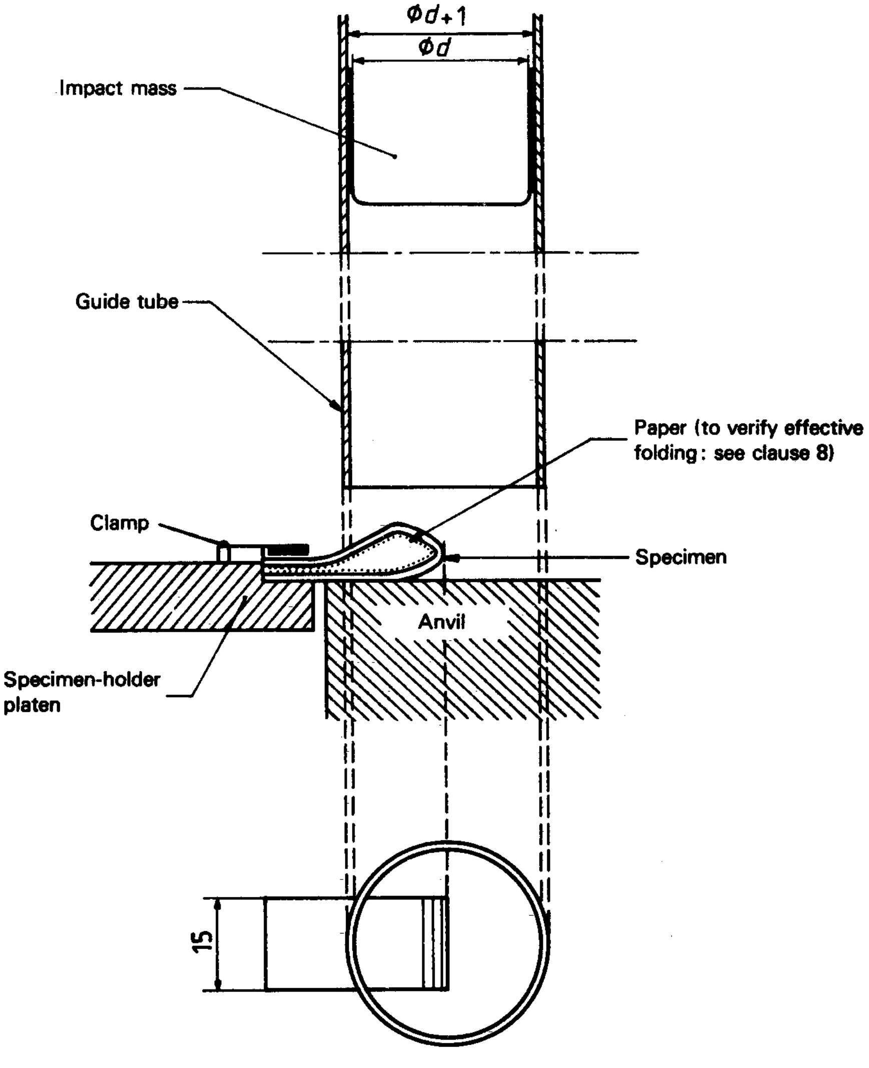


Figure 1 — Typical impact device for determination of cold-crack temperature

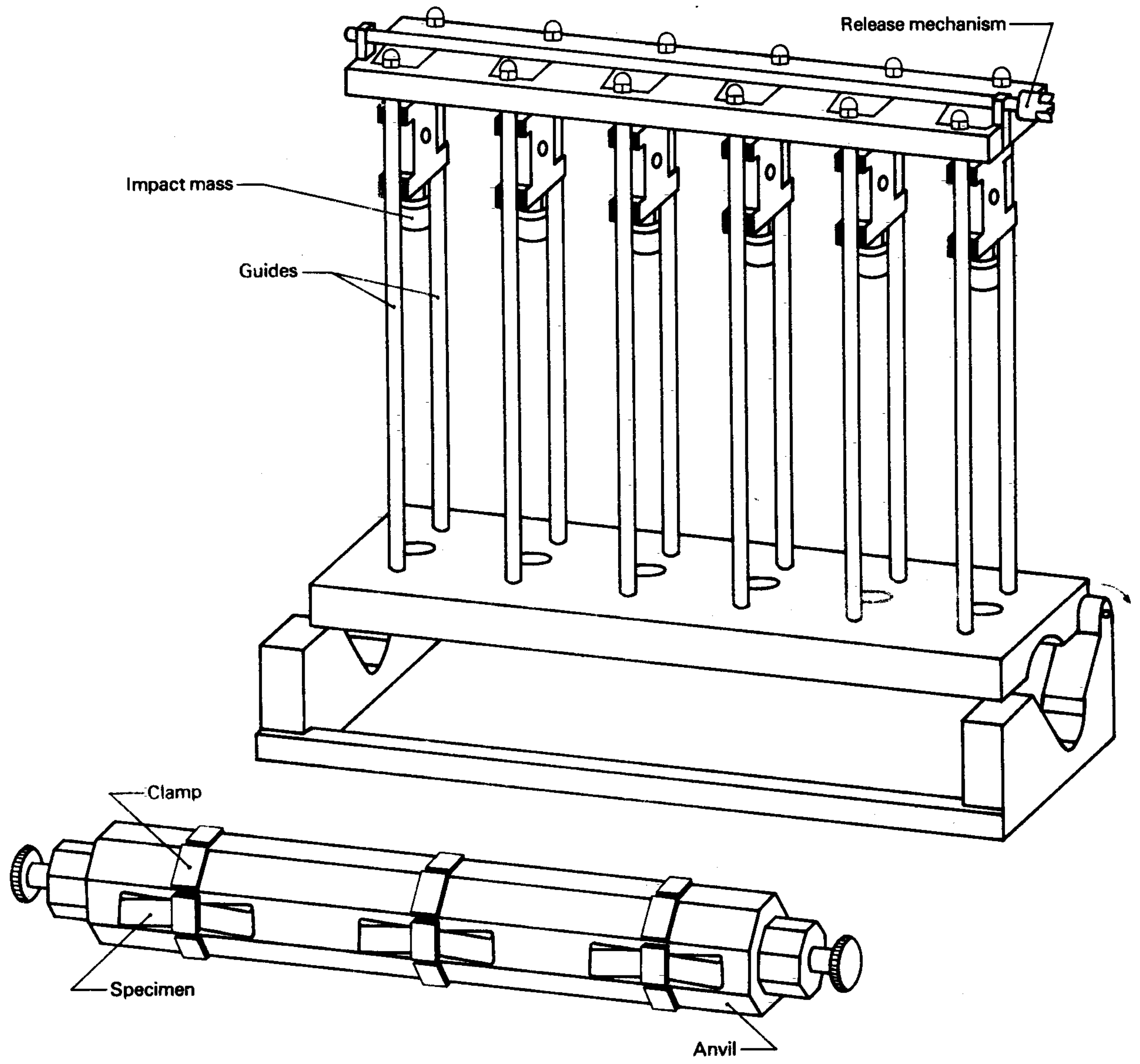


Figure 2 — Alternative design of cold-crack test apparatus

6 Specimens

6.1 Shape and dimensions

The specimens shall consist of strips measuring 60 mm × 15 mm. Their edges shall be free from cuts, scratches and other imperfections.

The thickness shall be measured in accordance with ISO 4593.

6.2 Taking specimens

For each temperature, 10 specimens shall be taken with their long axis (60 mm) parallel to the machine (i.e. longitudinal) direction, and 10 specimens with their long axis parallel to the transverse direction.

All specimens shall be taken at a distance of at least 150 mm from the edge and more than 1 m from the beginning or the end of the roll.

7 Conditioning of specimens

Bow the specimens in the form of loops and mount them in the specimen holder (5.1.1). If the film or sheeting is printed or textured on one side, this side shall be on the outside of the loop.

Condition the mounted specimens for a minimum of 3 h in one of the atmospheres specified in ISO 291.

8 Selection of impact mass

If there is no prior agreement upon the value of the impact mass, start the test with the 200 g mass, provided that this mass is sufficient to fold the specimen effectively. If this is not the case, use the 500 g mass.

The following criterion may be used to verify effective folding. Bend a strip of paper (about 70 g/m^2), of the same dimensions as the specimen, into a loop and place it inside the loop of a specimen. Test the combined plastic/paper specimen with the 200 g mass by the procedure given in clause 9, using a test temperature slightly higher than the cold-crack temperature in order to prevent the specimen breaking. Inspect the paper strip. A sharp crease at the tip of the loop indicates effective folding.

9 Procedure

9.1 Verify the alignment of the guide tube (5.1.4) with respect to the position of the specimen on the platen.

9.2 Place the impact device containing the mounted specimens in the cooling chamber (5.2). When the impact device has reached equilibrium at the test temperature (approximately 15 min), position the specimen (in the case of a revolving-type device, the first specimen) below the guide tube. Release the impact mass (5.1.3) then reset it to its initial position. Repeat the operation for the other specimens, if any.

Take the platen out of the cooling chamber, remove the specimens and inspect them.

A specimen is deemed to be damaged or broken if any trace of breaking is visible to the naked eye. This trace can be a point or a line, while total rupture may occur, with or without splintering (see figure 3). A whitish line at the fold may occur with certain types of pigmented or unpigmented material, but this is not considered as a failure.

9.3 If no specimen is damaged or broken, lower the temperature of the cooling chamber by 5 °C and repeat the test as specified in 9.1 and 9.2 with fresh specimens. If all the specimens are still unaffected, repeat the test at temperatures decreasing by 5 °C, with a new set of specimens each time. Record the number of specimens unbroken and broken or damaged at each temperature, applying the test criterion given in 9.2.

Continue the test until a temperature is reached at which all specimens are broken or damaged.

9.4 If, at the start of the test, one or more specimens is broken or damaged, repeat the test at temperatures increasing in increments of 5 °C until no specimen is damaged. From this point, follow the procedure described in 9.3.

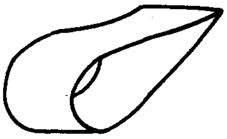
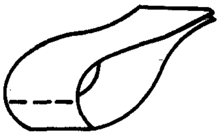
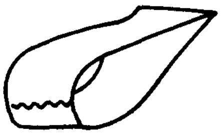
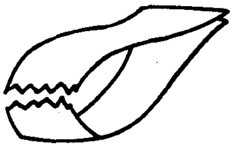
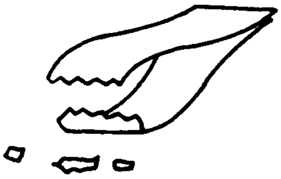
No sign of crack		
Broken or damaged	Trace of crack: points or dashes	
	Trace of crack: line	
	Total rupture: no fragments	
	Total rupture: with fragments	

Figure 3 — Rating of cold-crack specimens

10 Expression of results

10.1 Graphical method

Plot the percentage failure at each temperature against the test temperature on arithmetic-probability paper and draw the best straight line through the results. Read the cold-crack temperature from the graph (the point where this line intersects the 50 % probability line).

10.2 Calculation method

The cold-crack temperature t_B, in degrees Celsius, can be calculated as follows:

$$t_B = t_K + \Delta t\left(\frac{\sum n}{n_0} - 0,5\right)$$

where

t_K is the highest test temperature, in degrees Celsius, at which all specimens (normally 10) were broken or damaged;

Δt is the difference, in degrees Celsius, between two consecutive test temperatures (normally 5 °C);

$\sum n$ is the total number of all broken or damaged specimens (from the temperature t_K to the temperature at which no specimen is broken or damaged;

n_0 is the number of specimens tested at each temperature (normally 10).

11 Test report

The test report shall include the following particulars:

a) a reference to this International Standard;

b) all details necessary for the complete identification of the material tested, including thickness, date of manufacture and type of surface (printed, textured);

c) the cold-crack temperature, in degrees Celsius, with the impact mass in brackets, e.g. (200): − 13 °C, for both the machine (longitudinal) and the transverse directions;

d) the number of specimens tested at each temperature;

e) the type of failure (crack, rupture with fragments, rupture without fragments);

f) any deviations from the procedure specified.

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